

# Utilization of GOES Observation to Evaluate Cloud Prediction by the WRF

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## Motivation

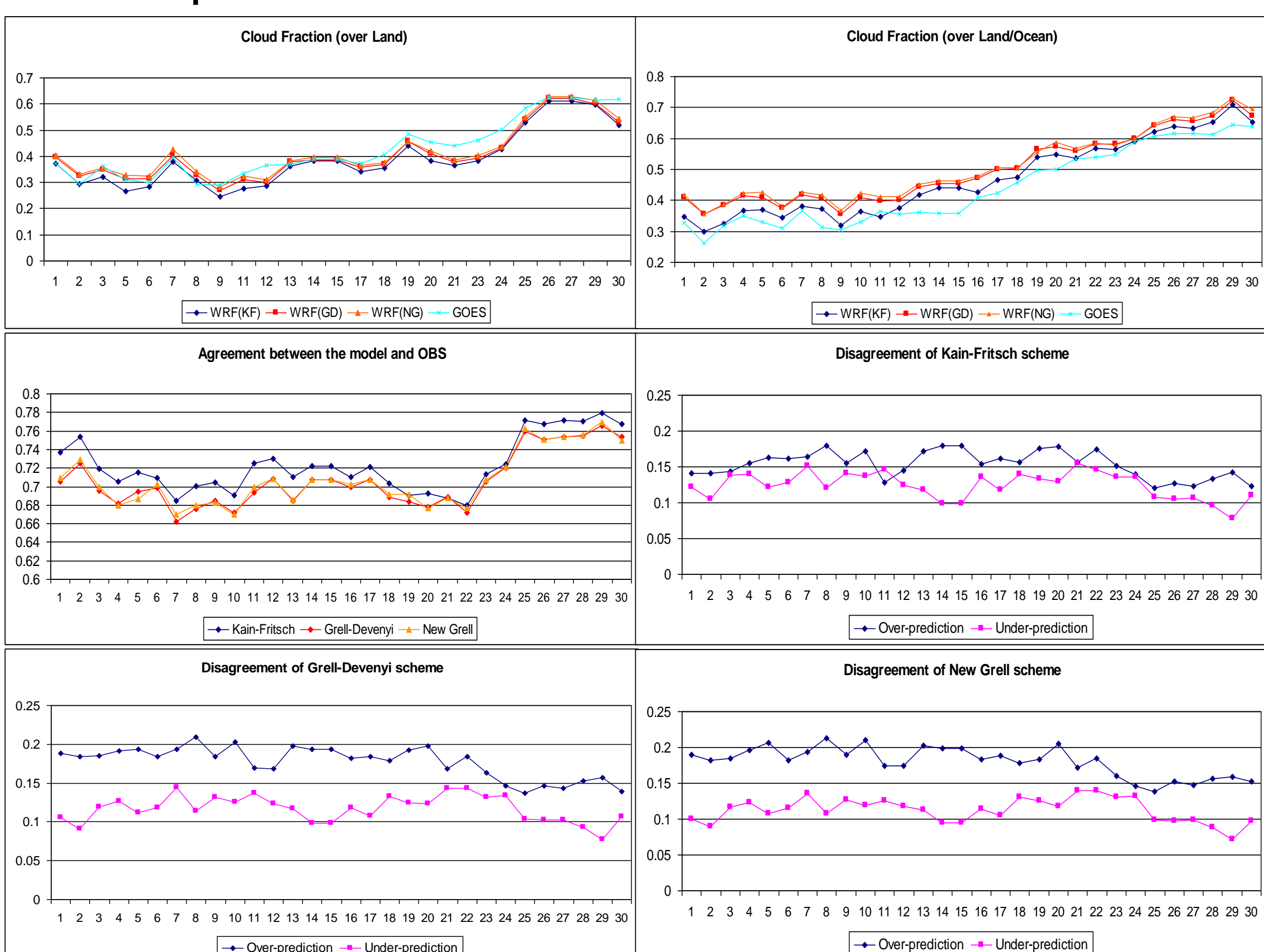
Clouds are one of the important contributors of the radiation energy balance and climate change as well as the Earth's hydrological system. Another key role of clouds on the air quality is that convective clouds transport pollutants from boundary layer to the free troposphere. Unfortunately, clouds are one of the least understood components of the Earth system. The objective of this research is to improve the cloud prediction in the Weather Research and Forecasting (WRF) meteorological model. In this study we use Geostationary Operating Environmental Satellite (GOES) observations of clouds to evaluate the performance of the WRF model with respect to cloud prediction. A detailed discussion of the evaluation for the month of August, 2006 is presented in this poster.

## Evaluation of three CPSs

Evaluation of the model and GOES: Using 'cloud albedo'

$$\alpha_{CLD} = 1 - \frac{Insolation}{Background\ Insolation}$$

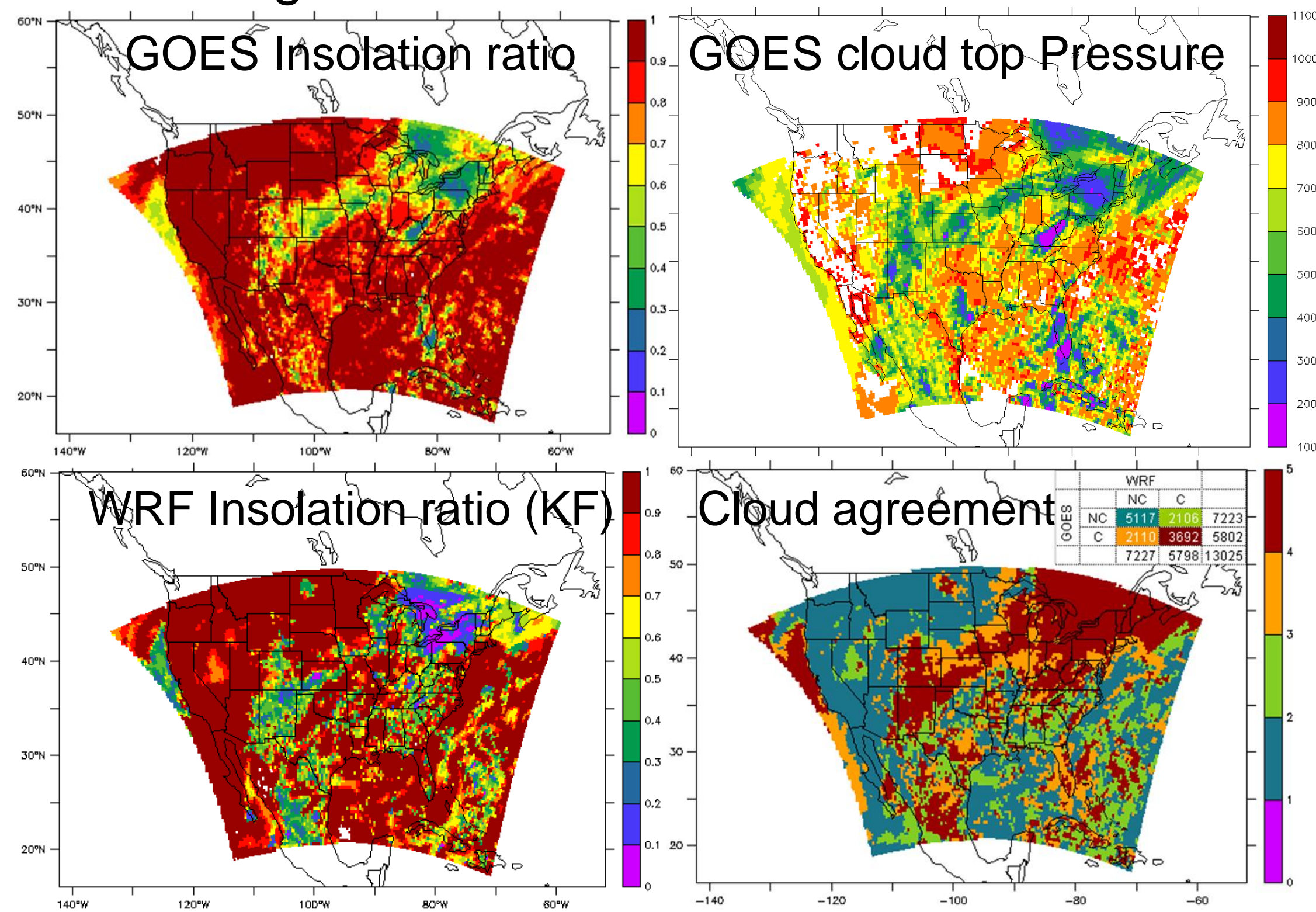
The 'Background Insolation' is taken from the maximum surface insolation for 31 days centered at each time. (the assumption is each pixel over each time has clear condition at least one day). Since the GOES data used is visible channel, daily time range for comparison is from 10 to 16 local time.



In August 2006, the difference between model cloud fraction and that of observation is not considerable. The reason for the overall increased cloud fraction toward the latter part of August is increased clouds over ocean.

## Cloud Agreement

Date: August 19<sup>th</sup> 2006 at 20GMT



Based on the cloud albedo, a contingency table is defined by this table.

Clear Agreement	Overprediction
Underprediction	Cloud Agreement

- Blue: the model and observation indicate clear condition
- Green: the model indicates cloud in clear condition (overprediction)
- Yellow: the model indicates clear condition in cloudy areas (underprediction)
- Red: both the model and observation indicate clouds

## Conclusion & Future Works

Cloud albedo calculated from surface insolation ratio is another indicator to evaluate the model. The fraction of clouds from the model is equivalent to GOES VIS images. Overall, the model over-predicts clouds for all three CPSs, but Kain-Fritsch scheme performed better in predicting clouds in this case study. A multi-linear regression equation, based on the relationship among cloud albedo, cloud liquid water and maximum vertical velocity, would adjust the meteorological fields of the areas where the model and the observation have disagreement. New horizontal wind fields will be generated for targeted vertical velocities and applied as nudging fields in WRF for cloud disagreement areas.

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